

# Empirical Study on Digital Inclusive Finance to Promote Rural Revitalization—Taking Five Northwestern Provinces as an Example

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**Abstract:** *The development of digital inclusive finance is an important measure to implement the rural revitalization strategy. Taking the villages in the five northwestern provinces as the research object, supported by the panel data of the five northwestern provinces from 2011 to 2020, and on the basis of constructing a rural revitalization measurement system, the paper empirically explored the intrinsic connection between digital inclusive finance and rural revitalization in the five northwestern provinces, and found that: digital inclusive finance can significantly promote rural revitalization in the five northwestern provinces, and this positive effect still holds after the endogeneity test and robustness test still holds. Meanwhile, under the heterogeneity characteristic test, regions under different boundary conditions present significant asymmetric effects: for example, Shaanxi Province has a higher level of economic development among the five Northwestern provinces, strong consumer demand, and a high degree of integrated development of urban and rural compulsory education, so the positive effect of digital inclusive finance development on rural revitalization is stronger in this province. Finally, digital inclusive finance can play the mechanization popularization effect, entrepreneurship incentive effect and income growth effect to promote rural revitalization development.*

**Keywords:** *Chinese Modernization, Digital Financial Inclusion, Rural Revitalization, Three Rural Issues*

## 1. Introduction

After winning the battle against poverty, the center of gravity of the "three rural areas" work has gradually shifted to rural revitalization. Under this ambitious goal, digital inclusive finance has ushered in more opportunities to support the real economy in the countryside. 2023 Central Document No.1 proposes to improve the multi-input mechanism for rural revitalization, and requires that rural inclusive finance be empowered by digital technology. The unbalanced and insufficient development of the five provinces in Northwest China is more prominent, and the local development is in urgent need of digital inclusive financial assistance. Therefore, it is of great significance to study and explore the current situation and development of digital inclusive finance in the five northwestern provinces<sup>[1]</sup>. Digital financial inclusion, supported by digital technology, stimulates rural mechanization to expand its reach, thereby contributing to rural revitalization in five northwestern provinces (Lin Li et al., 2019)<sup>[2]</sup>. Digital financial inclusion contributes to innovation and entrepreneurship among farmers, leveraging entrepreneurial incentives to increase farmers' incomes and boosting the rural digital economy. Digital financial inclusion promotes the development of agricultural e-commerce (Mao Yixuan, 2021)<sup>[3]</sup>. Combining digital inclusive finance and rural revitalization, taking the five northwestern provinces as an example, and referring to domestic and international research methods, this paper describes the role and mechanism of digital inclusive finance in rural revitalization, and provides empirical evidence and relevant recommendations for the implementation process, which can help achieve integrated prosperity in urban and rural areas.

The contribution of this paper is that it explores the economic effects of inclusive digital finance for rural revitalization from the perspective of rural revitalization in five northwestern provinces, and comprehensively measures rural revitalization indicators. After that, the internal logic between inclusive digital finance and rural revitalization is based on the three key effects of inclusive digital finance—mechanization popularization effect, entrepreneurship incentive effect, and income increase effect - and provides directions on how inclusive digital finance can contribute to rural revitalization in the five northwestern provinces.

## 2. Research on the Relationship between Digital Inclusive Finance and Rural Revitalization

### 2.1 Research Hypothesis

Compared with traditional finance, digital inclusive finance can break through geographical and time constraints and surpass traditional finance in terms of low transaction costs and fast transaction speeds to promote rural economic development in the five northwestern provinces. Hypothesis 1: Digital inclusive finance can promote rural revitalization in the five northwestern provinces.

Mechanization popularization effect. Digital inclusive finance refers to the realization of innovative methods combining technology and finance, which makes it possible to purchase agricultural machinery from the manufacturing side; it can also provide financial support for agricultural machinery production on the supply side, and together contribute to the popularization of mechanized production in rural areas. Hypothesis 2: Digital inclusive finance can contribute to rural revitalization in the five northwestern provinces by leveraging the popularization effect of mechanization.

Entrepreneurial incentive effects. With the support of big data, digital inclusive finance can help farmers better judge whether an entrepreneurial project has development prospects. At the same time, it can also broaden financing channels, solve financing difficulties, create more jobs to attract farmers in Northwest China to return to their hometowns for employment, and help rural revitalization in Northwest China. Hypothesis 3: Digital inclusive finance can promote rural revitalization in the five northwestern provinces by exerting entrepreneurial incentive effects.

Income growth effect. Some economically developed areas in the five northwestern provinces have been able to boost disadvantaged groups in other more disadvantaged areas, reflecting the income growth effect. Digital financial inclusion provides farmers with rich and effective ways to manage their finances, generating more income for farmers. It can improve the education level of Northwest families. Digital inclusive finance can develop financial products adapted to rural education through the Internet and cloud computing. Hypothesis 4: Digital inclusive finance can promote rural revitalization in the five northwestern provinces by exerting income growth effects<sup>[4]</sup>.

### 2.2 Variable Settings

Table 1: Indicator system for rural revitalization in five northwest provinces

Key indicators	Secondary indicators	Methodology for measuring secondary indicators	Methods of influence
Thriving industry	Production efficiency	Rural per capita value of agricultural, forestry, livestock and fishery production	+
	Diversification of production	Non-cereal sown area/Total sown area	+
	Production stability	Effective irrigated area/Cropland area	+
Ecologically livable	Ecological environment	Forest cover	+
	Hygienic environment	Rural health technicians per 10,000 population	+
	Social environment	Percentage of people with minimum subsistence allowance in rural areas	-
	Communications environment	Number of rural broadband access subscribers/Number of rural people	+
Local customs and civilization	Educational attainment	Percentage of illiterate population over 15 years of age	-
	Cultural development	Comprehensive rural radio program coverage	+
	Recreation accessibility	Number of rural cable radio and television subscribers/Total number of households	+
Effective governance	Level of autonomy	Units of self-government organizations per 10,000 persons in rural areas	+
	Management level	Number of village committee units per 10,000 people in rural areas	+
	Urban-rural consumption gap	Rural consumption/urban consumption	+
	Urban-rural income gap	Rural income/urban income	+
	Income structure	Wage income/Total income of rural residents	+
Prosperity	Engel's coefficient	Rural expenditure on food, tobacco and alcohol/Total consumption expenditure	-
	Consumer structure	Rural expenditure on education, culture and recreation as a percentage of total consumption expenditure	+

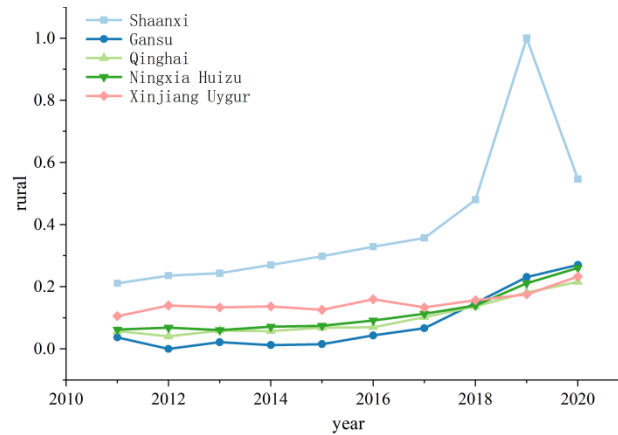


Figure 1: Score on the degree of development of rural revitalization in each region of the five northwestern provinces under the TOPSIS entropy weight method

(1) Explained variable: Rural revitalization (*rural*). Based on digital financial inclusion and the internal logic of "industrial prosperity, ecological livability, civilized rural culture, effective governance, and affluent life" put forward by the 19th National Congress, a rural revitalization measurement system is constructed based on the five primary indicators and 17 secondary indicators of the five northwestern provinces, as shown in Table 1. In order to ensure the credibility of the evaluation results, this paper measures the development degree of rural revitalization in the five northwestern provinces through the entropy weight method of TOPSIS, as shown in Figure 1.

(2) Core variables Digital financial inclusion (*dif*): 2011-2020 digital financial inclusion index from Institute of Digital Finance, Peking University, contains three dimensions: breadth of digital financial coverage (*dif1*), depth of use (*dif2*) and degree of digitized support services degree (*dif3*).

(3) Mechanism variables Mechanization level (*mech*): due to the difference in the area of agricultural land in the five northwestern provinces in 2011-2020, the level of mechanization penetration is measured in terms of the unit of agricultural machinery power (agricultural machinery power/area of agricultural land).

(4) Entrepreneurial incentives (*job*): measured by the sum of rural self-employment and private enterprise employment as a share of the rural population.

(5) Income growth (*income*): measured by disposable income per rural resident.

(6) Control variables Economic development (*gdp*, GDP per capita), government intervention (*gov*, ratio of expenditure on agriculture, forestry and water affairs to fiscal expenditure), urbanization level (*urb*, urbanization rate), foreign trade (*fore*, amount of foreign investment), industrial structure (*ind*, ratio of increase in the secondary industry to GDP), and demographic status (*old*, dependency ratio of the elderly population).

### 2.3 Empirical Strategy

#### 1) Basic Regression Model

$$rural_{i,t} = \alpha_0 + \alpha_1 dif_{i,t} + \alpha CV_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{1}$$

#### 2) Mechanism Effects Model

Based on the theoretical assumption that digital inclusive finance promotes the development of rural revitalization by exerting three major effects, in order to verify the above inference, this paper launches a mechanism study and tests it by using the bootstrap method (100 times):

$$rural_{i,t} = \alpha_0 + \alpha_1 dif_{i,t} + \alpha CV_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{2}$$

$$median_{i,t} = \beta_0 + \beta_1 dif_{i,t} + \beta CV_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{3}$$

$$rural_{i,t} = \gamma_0 + \gamma_1 dif_{i,t} + \gamma_2 median_{i,t} + \gamma CV_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \tag{4}$$

Significance of  $\alpha_1$  is the premise of the mechanism test, but also need to pay attention to the coefficient  $\beta_1, \gamma_1, \gamma_2$ , the level of significance of the judgment of whether the coefficient is fully mediated or partially mediated. Finally,  $\beta_1 \times \gamma_2$  with the same positive and negative sign as  $\gamma_1$  is required to confirm that the mediating effect holds.

### 3. Empirical analysis

#### 3.1 Base Regression Analysis

The results were obtained from the regression analysis of the variables related to the five northwestern provinces according to Table 2. Model (1) utilizes ordinary least squares regression, model (2) adds province fixed effects, and model (3) adds control variables. Model (4) further controls for year and province fixed effects on the basis of adding control variables. As can be seen from the results, the coefficients of digital financial inclusion are all greater than zero and the probability passes the significance test at the 1% level. From the results of model (4), every 1% increase in the digital financial inclusion index corresponds to a 0.081% increase in the development of rural revitalization, which concludes that digital financial inclusion can help rural revitalization and development, and hypothesis 1 is valid. Analysis of the results of model (4): the level of urbanization hinders the development of rural revitalization, and the human resources and professionals needed for rural revitalization are then lacking; the increase of the proportion of the secondary industry in the industrial structure and the increase of the old-age population dependency ratio in the demographic situation help the development of rural revitalization. In the industrial development, focusing on making up the short board of old age; and the influence of gov, gdp, fore on rural revitalization is not obvious, as shown in Table 2.

Table 2: Benchmark regression results

Explanatory variable	(1)	(2)	(3)	(4)
<i>dif</i>	0.095***	0.260***	0.038***	0.081***
	-0.022	-0.231	-0.088	-0.015
<i>gdp</i>			0.325	0.088
			-0.338	-0.595
<i>gov</i>			-1.501*	-0.076
			-0.88	-1.094
<i>urb</i>			-1.261***	-0.161***
			-2.044	-4.42
<i>fore</i>			-0.035	-0.036
			-0.062	-0.072
<i>ind</i>			0.211	0.404**
			-0.4	-0.478
<i>old</i>			0.268	0.050**
			-0.252	-0.285
<i>cons</i>	0.015***	0.045***	-3.464	0.685***
	-0.048	-0.043	-2.495	-5.919
<i>province</i>	NO	YES	YES	YES
<i>year</i>	NO	NO	NO	YES
<i>N</i>	50	50	50	50
<i>adj.R<sup>2</sup></i>	0.258	0.659	0.678	0.707

#### 3.2 Endogeneity test

Despite controlling for variables in the baseline regression and adopting double fixed effects, the problem of endogeneity remains. In this paper, further estimation is developed using the instrumental variable (IV) method. Wu, Zhirong (2009) argues that after mankind entered the industrialized society, the emergence of modern communication methods such as post and telegraph improved the efficiency of information exchange<sup>[5]</sup>. This paper chooses the per capita postal and telecommunications business volume of the five northwestern provinces in 2015 as the instrumental variable. Since the data of per capita postal and telecommunications business volume in 2015 in the five northwestern provinces are cross-sectional data, they do not have time attributes, which will lead to the failure of the two-stage test. Therefore, drawing on Zhang Xun (2020)<sup>[6]</sup>, this variable is interacted with the mean value of digital financial inclusion (except for the province) to form a new instrumental variable, denoted postal. In addition, to ensure the robustness of the results, drawing on Sun, Xuetao et al. (2022), a lag of one period is used as a second instrumental variable, noting l.dif<sup>[7]</sup>.

According to the results of Table 3: model (1) and model (2) are the results of using the cross-multiplication term between the per capita postal and telecommunications business and the mean value

of digital financial inclusion (except for the province) as instrumental variables; model (3) is the result of using the digital financial inclusion index with one period of lag as an instrumental variable. First of all, the two regressions I stage Monsman test probability is significantly 0, rejecting the original hypothesis indicates that the model has endogeneity problems; in addition, the F value of 13.64 is greater than 10 and passes the 1% significance test, then there is no weakly correlated variable; two instrumental variables coefficients are positive and also pass the 1% significance test, which indicates that the instrumental variables are positively correlated with the digital financial inclusion; lastly, the results of the two sets of II stage index are significant on 1%, then hypothesis 1 is further verified, as shown in Table 3.

Table 3: Endogeneity Test

Explanatory variable	(1)	(2)	(3)	(4)
	posal		One period behind	
	Stage I	Stage II	Stage I	Stage II
	<i>dif</i>	<i>rural</i>	<i>dif</i>	<i>rural</i>
<i>dif</i>		0.339*** (0.199)		0.030*** (0.017)
<i>control variables</i>	control	control	control	control
<i>cons</i>	-1.270*** (2.096)	0.056*** (0.073)	1.593* (0.837)	0.031*** (0.063)
<i>postal</i>	0.012*** (0.001)			
<i>l.dif</i>			2.689*** (2.277)	
<i>Prob&gt;F</i>	0.000 0		0.000 0	
<i>Husaman P</i>	0.000 0		0.000 0	
<i>province</i>	YES	YES	YES	YES
<i>year</i>	YES	YES	YES	YES
<i>N</i>	50	50	45	45
<i>adj.R2</i>	0.994	0.929	0.962	0.996

3.3 Robustness Check

(1) Excluding time panel data. Influenced by the macro policy, i.e., in November 2013, the conference proposed to "develop inclusive finance and enrich the levels and products of the financial market", China's digital inclusive finance gradually ushered in a brand-new stage of development. This paper will exclude the samples before 2013 (including 2013). As shown in Table 4, the results of model (1) show that after part of the time panel data is excluded, the digital financial inclusion index of the five Northwest provinces still plays an important role in rural revitalization, which confirms the robustness of the core conclusions of this paper.

(2) Excluding regional panel data. The different levels of development in the five Northwest provinces may make the enabling effect of digital inclusive finance on rural revitalization different. Therefore, this paper excludes the less developed autonomous regions of Xinjiang and Ningxia, and regresses to analyze the remaining data. As shown in Table 4, the results of model (2) show that after some data are excluded, the coefficients and significance of digital inclusive finance are similar to those of the benchmark regression results, confirming the robustness of the core conclusions of this paper.

Table 4: Robustness Test Results

Explanatory variable	(1)	(2)	(3)	(4)	(5)
	Reject time panel	Excluding regional panels	Breadth of coverage	Depth of use	Degree of digitization
<i>dif</i>	0.165*** (0.033)	0.105*** (0.023)			
<i>dif1</i>			0.089*** (0.026)		
<i>dif2</i>				0.094*** (0.016)	
<i>dif3</i>					0.084*** (0.007)
<i>control variables</i>	control	control	control	control	control
<i>_cons</i>	0.011 (0.061)	0.008 (0.050)	0.007 (0.036)	0.012 (0.030)	0.015 (0.027)
<i>Province</i>	YES	YES	YES	YES	YES
<i>Year</i>	YES	YES	YES	YES	YES
<i>N</i>	35	30	50	50	50
<i>adj.R2</i>	0.986	0.972	0.942	0.961	0.959

(3) Sub-dimension test. This paper divides the index into three dimensions: breadth of coverage, depth

of use, and degree of digital support services. Among them, the breadth of coverage measures the popularity of digital inclusive finance; the depth of use measures the frequency of users' use of digital inclusive financial services and products; and the degree of digital support services measures the level of facilitation of digital inclusive financial services.<sup>[8]</sup> As shown in Table 4, the estimation results are shown in model (3)(4)(5), the regression coefficients of the sub-dimensions of digital financial inclusion in the five Northwestern provinces are significant at the 1% level and positive, i.e., rural revitalization can be facilitated through the three dimensions of digital financial inclusion, and the robustness of the core conclusions of this paper is confirmed.

### 3.4 Heterogeneity Analysis

To explore the intrinsic connection between digital financial inclusion and rural revitalization in five northwestern provinces and analyze the heterogeneous effects. First, education plays a fundamental and pioneering role in rural revitalization. Second, encouraging the continuous expansion and upgrading of rural consumption is an indispensable part of rural revitalization. Based on this, the development of the pattern of the two will affect the pace of advancing rural revitalization. Therefore, group regression was used to test the above relationship.

As shown in Table 5, model (1)(2) is the result of grouping based on the median share of education and recreation expenditures of rural households. The impact of digital financial inclusion on rural revitalization in areas with different levels of education is positive and passes the 1% significance test, with the positive effect being more pronounced in areas with high levels of education. The statistical chi-square value is 3.22 which is significant at 10% level. This suggests that, in general, people in areas with high levels of education tend to have higher levels of financial sensitivity, etc. In contrast, the construction of financial infrastructure in rural areas with a relatively low level of education is lagging behind. Therefore, the contribution of digital inclusive finance to rural revitalization is stronger in rural areas in the five northwestern provinces with higher education levels.

As shown in Table 5, models (3)(4) are the results of grouping based on the median per capita consumption expenditure of rural residents. The rural revitalization impact of digital financial inclusion in different consumption demand regions is positive and passes the 1% significance test, with a more pronounced marginal propulsion effect in high consumption regions. The chi-square value is 5.36, significant at 5% level. It indicates that digital inclusive finance is more able to promote the development of rural revitalization in high consumption areas. This is due to the fact that financial products increase with the expansion and upgrading of residents' consumption, effectively reducing the liquidity of funds, according to the theory of diminishing marginal propensity to consume, which in turn promotes the promotion of digital inclusive finance among rural areas<sup>[9]</sup>. At the same time, in general, high-consumption areas are more economically developed, and it is easier to form the scale effect of digital inclusive finance, which has a stronger role in promoting rural revitalization.

Table 5: Heterogeneity Regression Results

Explanatory variable	(1)	(2)	(3)	(4)
	High level of education	Low level of education	High consumption demand	Low consumption demand
<i>dif</i>	0.180*** (0.060)	0.042*** (0.011)	0.199*** (0.067)	0.037*** (0.024)
<i>control variables</i>	control	control	control	control
<i>cons</i>	-0.194 (0.144)	0.044** (0.020)	0.199*** (0.067)	0.085** (0.034)
<i>chi P</i>	3.22**		5.36**	
<i>Province</i>	YES	YES	YES	YES
<i>Year</i>	YES	YES	YES	YES
<i>N</i>	25	25	25	25
<i>adj.R<sup>2</sup></i>	0.9825	0.9768	0.9767	0.8659

## 4. Mechanism Pathway Identification Test

Based on the theoretical assumptions, the path mechanism of digital inclusive finance affecting rural revitalization in the five northwestern provinces is identified and tested from the three dimensions of mechanization popularization effect, entrepreneurship incentive effect and income growth effect. The results of digital inclusive finance mechanization popularization effect are expressed through model (1)(2)(3). As shown in Table 6, model (1) is the same as the benchmark regression results; model (2) passed the significance test at the 5% level, and the regression coefficient of digital financial inclusion is

positive, which indicates that the opportunity of digital financial inclusion should be fully used to accelerate agricultural mechanization and improve the level of agricultural development, and this is also consistent with the conclusion of the study by Xu Jundi<sup>[10]</sup>. Model (3) digital financial inclusion and agricultural mechanization coefficients of the five northwestern provinces are 0.084 and 0.123 and both are significant, passing the 1% significance test in bootstrap method, that is, hypothesis 2 is established.

As shown in Table 6, model (1)(4)(5) explores the path mechanism of digital financial inclusion entrepreneurship incentives. Digital financial inclusion in model (4) significantly promotes rural entrepreneurship growth, which is also consistent with the findings of Chen Zhongying, Wang Linping<sup>[11]</sup>. Model (5) yields positive and significant coefficients of digital financial inclusion and farmers' entrepreneurship in the five northwestern provinces, which passes the 1% significance level test, i.e., hypothesis 3 is valid.

As shown in Table 6, model (1)(6)(7) shows the path mechanism of the income growth effect of digital financial inclusion. Digital financial inclusion in model (6) significantly contributes to the increase of rural income level, which is also consistent with the findings of Zhang Jinchen's study<sup>[12]</sup>. The coefficient of model (7) digital financial inclusion and farm household income level is positive and significant and passes the 5% significance level test, i.e. hypothesis 4 holds.

Table 6: Mechanism Test Regression Results

Explanatory variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Mechanization effect		Entrepreneurial incentive effects		Income growth effect	
	<i>rural</i>	<i>mech</i>	<i>rural</i>	<i>job</i>	<i>rural</i>	<i>income</i>	<i>rural</i>
<i>dif</i>	0.081*** (0.015)	0.137** (0.068)	0.084*** (0.015)	0.235*** (0.069)	0.086*** (0.015)	0.560*** (0.074)	0.080*** (0.014)
<i>mech</i>			0.123** (0.041)				
<i>job</i>					0.247** (0.103)		
<i>Income</i>							0.065** (0.030)
<i>control variables</i>	control	control	control	control	control	control	control
<i>_cons</i>	0.011 (0.033)	1.849*** (0.160)	0.184*** (0.028)	0.030* (0.016)	0.096*** (0.034)	4.464*** (0.155)	-0.191 (0.154)
<i>bootstrap p val</i>		0.001		0.001		0.013	
<i>Mechanism identification</i>		Indirect effects hold		Indirect effects hold		Indirect effects hold	
		Mechanism established -Positive conduction		Mechanism established -Positive conduction		Mechanism established -Positive conduction	
<i>Province</i>	YES	YES	YES	YES	YES	YES	YES
<i>Year</i>	YES	YES	YES	YES	YES	YES	YES
<i>N</i>	50	50	50	50	50	50	50
<i>adj.R<sup>2</sup></i>	0.922	0.653	0.926	0.894	0.927	0.981	0.923

## 5. Conclusions

Comprehensively promoting rural revitalization and unimpeded urban-rural economic circulation is an important part of building a new development pattern. This paper summarizes the conclusions through empirical analysis of the application of digital inclusive finance in rural revitalization in the northwest region of China: firstly, the development of digital inclusive finance has greatly helped rural revitalization in the five northwestern provinces, especially in the regions with large differences in the level of economic development, which has produced obvious asymmetric effects. Regions with higher levels of economic development have stronger economic effects on digital financial inclusion, while on the contrary, regions with lower levels of economic development have weaker economic effects on digital financial inclusion. For example, Shaanxi Province has a higher level of economic development among the five northwestern provinces, more robust consumer demand, and a high degree of integrated development of urban and rural compulsory education, so the province's digital inclusive financial development has a stronger positive effect on rural revitalization. Secondly, digital inclusive finance can play three major effects to meet the multi-level and diversified needs of farmers in Northwest China.

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